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Allocative Efficiency of 'Egusi' Melon (*Colocynthis citrullus lanatus)* Production Inputs in Owerri West Local Government Area of Imo State, Nigeria

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ABSTRACT Investigating the allocative efficiency of 'egusi' melon production inputs in Owerri West Local Government Area of Imo State, Nigeria, this study utilized information generated from 60 respondents selected by multistage random sampling technique. Cross sectional primary data were obtained through the administration of questionnaire to the respondents and their memory recall. The articulated data were analyzed by means of non-parametric and parametric statistics. Farmers in the area still produce "egusi' melon because of its socio-economic and cultural values such as income generation, local soup preparation and weed suppressant in mixed crop farms. Results of data analysis implicated household size, cost of inputs and farm size as significant determinants of production output. Production output was also positively influenced by land, labour (family and hired), fertilizer, capital and seed inputs, but significantly determined by land and fertilizer inputs. More so, computed allocative efficiency values showed that land (1.14), fertilizer (17.44) and seed (1.76) inputs were under utilized, while family labour (0.64), hired labour (0.08) and capital (0.83) inputs were over utilized. The serious problems of melon production were lack of land, high cost of inputs and inadequate processing facilities. Government should subsidize cost of inputs especially fertilizers and provide cheap credit facilities in order to facilitate increase in productivity and sustainability of 'egusi' melon production in the area.

INTRODUCION

'Egusi' melon (*Colocynthis citrullus lanatus*) is a vegetable crop commonly cultivated in West Africa (van der Vossen et al. 2004). Because of its creeping nature and ability to use its leaves to provide cover on the soil, farmers use it as weed suppressant in their mixed crop farms. According to Achigan-Dako et al. (2008), 'egusi' melons play vital roles in the farming system and in the well-being of West African rural dwellers as weed suppressants and for soil fertilization. Further studies by Achigan-Dako et al. (2008) summarized the socio-cultural uses of 'egusi' melons to include the provision of cash income, household food, gift to relatives and seeds. The seed kernels are rich in healthy fatty acids, minerals and proteins. The kernels could be ground into paste used in preparing local soup or fried in vegetable oil to obtain melon snack ("robo"). The oil extract from the seeds is mostly used for cooking purposes and could also be used for producing biscuits, margarines and soaps (Ajibola 1990). In the Republic of Benin, some farmers also reported the medicinal role of some 'egusi' species such as *C. lanatus subsp. mucosospermus*. The sliced young fruit of this specie is said to heal stomach aches while the seed coat in decoction with Eucalyptus (*Eucalyptus camaldulensis* Dehnh.) roots is a sedative for epilepsy. The roasted seeds, ground with salt are taken with warm water or porridge to prevent vomiting (Achigan-Dako et al. 2008).

Production of the crop is more popular in the northern parts of Nigeria where there is abundance of cultivable land which has made the practice of sole and mixed cropping possible (Yusuf et al. 2008). This is unlike the eastern parts of the country, which the study area is part of, where scarcity of farm land has forced majority of the farmers to raise the crop in mixed crop farms. Despite the socio-economic importance of 'egusi' melon, production output has been on the decline. The reasons for this decline could be attributed to the problems of scarcity of land resulting from land fragmentation, high cost of inputs, use of traditional techniques, inefficient allocation of resources and so on. To achieve economic optimum output and thus profitability, resources have to be optimally and efficiently utilized. According to Debertin (1986), the efficiency of input utilization in any agricultural enterprise enhances the profitability of such an enterprise. Efficiency measurement is very important because it is a factor for productivity growth. Allocative efficiency studies

help farmers to determine the extent to which they can appropriately adjust productive resources in order to achieve optimum productivity.

The production of 'egusi' melon is declining in the study area, but the crop plays many vital socio-economic and cultural roles in the well-being of the farmers and communities. Since no study has been done to determine the allocative efficiency of 'egusi' melon production inputs in the area, this study was therefore timely. It enabled the determination of allocative efficiency levels of the various 'egusi' melon production resources, the impact of socio-economic factors on production output and the problems of 'egusi' melon production. The findings would help in the advocacy of policy that would usher in sustainability and improvement in production of the crop.

METHODOLOGY

The study area is Owerri West Local Government Area (LGA) of Imo State**.** It is one of the 27 LGAs comprising Imo State. The climate is tropical, marked by two distinct seasons: the dry and rainy seasons. The average monthly rainfall is between 1200mm to 2000mm and the average temperature is 30^{o}C. The LGA is made up of 14 autonomous communities namely, Umugumar, Avu, Okuku, Irete, Obinze, Oforola, Nekede, Ihiagwo, Eziobodo, Okolochi, Emiabian, Amakohia, Orokwe and Ndukwe. The LGA was chosen for the study because of observable evidence of 'egusi' melon production by virtually every farm household.

A multi-stage simple random sampling method was deployed to select four communities from these 14 communities and then 15 melon farmers from each of the four communities to arrive at a total of 60 respondents for the study. Both primary and secondary data were used for the study. Primary data were generated from structured questionnaires administered to the 60 respondents. Data were collected on socio-economic factors, inputs and output variables, their current market prices and production problems. The generated data were analyzed using non-parametric statistics (averages, frequency distribution, percentages and ratios) and parametric statistics (t, F and Durbin-Watson statistics in multiple regressions). Secondary data were sourced from relevant publications and used to compliment primary data for the write-ups.

The implicit form of the regression models used to examine the effects of socio-economic factors of the respondents on production output as well as to determine the magnitude of input parameters employed to calculate the respective marginal value products of the inputs is given as:

$Y = f(X_1, X_2, ..., X_n ; e)$

Where:

Y = dependent variable

$X_1, X_2, \ldots\ldots\ldots, X_n$ = independent variables

e = error term

Four functional forms were tried and their explicit expressions are stated as:

Linear : $Y = b_0 + b_1X_1 + b_2 X_2 + ... + b_n X_n + e$

Exponentia l : $\ln Y = b_0 + b_1X_1 + b_2 X_2 + ... + b_n X_n + e$

Semi - log *:* $Y = b_0 + b_1 \ln X_1 + b_2 X_2 + ... + b_n \ln X_n + e$

Double - log *:* $\ln Y = b_0 + b_1 \ln X_1 + b_2 X_2 + ... + b_n \ln X_n + e$

For the effects of socio-economic variables on output, the variables were represented as:

Y = output (kg)

X_1 = age (years)

X_2 = household size (number)

X_3 = educational attainment (years)

X_4 = experience (years)

X_5 = cost of input (₦)

X_6 = access to credit (dummy: accessed credit =1; otherwise = 0)

X_7 = cost of input (₦)

X_8 = farm area (m^2)

The estimation of resource use efficiency parameters was done with the dependent and independent variables represented as:

Y = output (kg)

X_1 = land area (m^2)

X_2 = family labour (₦)

X_3 = hired labour (₦)

X_4 = fertilizer (₦)

X_5 = capital (₦)

X^6 = seed (₦)

b_o = constant in each case

b_i = regression coefficients

e = error term

Output of the regression model found best fit for each set of data, that is, data for the influence of socio-economic factors on output

or data for the estimation of resource use efficiency parameters' was adopted for results presentation. The criteria used for the selection were:

* the number, signs and magnitudes of significant estimators.
* the magnitude of R^2, the coefficient of determination, showing the percentage of variation in output explained by the independent variables.
* the F-statistic value showing the overall significance of the regression parameters.
* the Durbin-Watson statistic value indicating the existence or non-existence of multi-collinearity.

At last, the linear regression model was selected for estimating the influence of socio-economic factors on output, while the Cobb-Douglas functional form came out best for the estimation of the parameters used in the computation of marginal value products (MVPs) of 'egusi' melon production inputs. The MVP was computed for each input as the product of its regression coefficient and the geometric mean value of farm revenue and the farm input. That is:

$$MVP = B_i \text{ x} \frac{\overline{Y}}{\overline{X}_i} \text{x } P_y$$

Where: MVP and bi are as defined earlier

$\overline{Y}$ = mean of output

$\overline{X}_i$ = mean of variable input

P_y = per unit price of output, which was gotten by dividing total revenue by the quantity of melon produced.

In order to determine the allocative efficiency value of the various inputs, the ratio of MVP to MFC for each of the input was calculated as:

MVP/MFC

Where:

MVP is as defined above

MFC = cost per unit of the i^{th} input used in the production process. It was obtained by dividing the total cost of the i^{th} input by the quantity of such input used in the production (Inoni 2007) or the opportunity cost / average market price of each input in a competitive market.

A given resource is optimally allocated when there is no divergence between its MVP and its acquisition cost (i.e. marginal factor cost (MFC)). A firm maximizes its profit with respect to an input if the ratio of its MVP to MFC is unity. A ratio less than unity shows over utilization of that resource and profit would be increased by decreasing the quantity used of that input. Resource under utilization is indicated by a ratio greater than one and profit would be increased by increase in the rate of its use. Mathematically:

If, *MVP/MFC* = 1, use of the resource is at optimum (optimum utilization)

MVP/MFC < 1, use of the resource is above optimum (over utilization)

MVP/MFC > 1, use of the resource is below optimum (under utilization)

RESULTS AND DISCUSSION

Effects of Socio-economic Characteristics of Respondents on Production Output

The multiple regression analysis was used to determine the impact of independent variables (AGE, HOS, EDU, EXP, COI, ACC, and FAS) on the dependent variable (output). The output of the linear regression version which was deployed for the analysis (Table 1) showed an R^2 value of 0.685. This implies that about 69% of the variation in output of the respondents was accounted for by joint action of the seven independent factors, while the rest 31% of the variation was due to error. The overall regression result was significant as F-statistic value of 694.24 was significant at 5% level of probability. Again, the Durbin-Watson value of 1.89, which is approximately equal to two, indicated the absence of multi-collinearity.

The regression coefficient of household size, cost of inputs and farm size were significant at 5% probability level, thus making the three factors important determinants of output from melon production. The other four factors, age,

Table 1: Estimated impacts of socio-economic factors of respondents on production output

Factor	*Standardized coefficient*	*t-statistic*	*Probability*
Constant	0.372	2.476	0.023*
AGE	0.133	1.272	0.224
HOS	0.402	-2.762	0.002*
EDU	520	1.162	0.426
EXP	194	1.842	0.584
COI	356	-2.153	0.003*
ACC	578	1.630	0.164
FAS	284	7.613	0.000*
F-statistic	694.24		0.000*
R^2	0.685		
R^2 (adjusted)	0.681		
Durbin-Watson statistic		1.89	

Source: Field survey 2010

education, experience and access to credit were not significant and therefore constituted weak determinants of production output. Household size as an important determinant of income had a negative sign, implying that the higher the size the lower the output. This is contrary to *a priori* expectations that large household size eases labour problems thereby leading to higher productivity and income. However, it agrees with Onyenweaku and Nwaru (2005) who reported the same negative relationship between household size and technical efficiency in food crop production in Imo State.

Cost of inputs had a negative relationship with output as expected. It is usual that high cost of inputs decreases output from any production outfit. This result corroborates Ohajianya et al. (2010) that high cost of inputs would lead to reduction in output or income generated by women farmers in Imo State. Furthermore, farm size was significant and positively signed in accordance with *a priori* expectations. That is, farmers with large farm sizes are more likely to produce more melon than their counterparts with small farm sizes. Ugwumba and Orji (2006), Ugwumba (2010) respectively reported similar result in traditional farming system and its effect on farm cash income and resource use efficiency and determinants of catfish production output both in Anambra State, Nigeria.

Allocative Efficiency of 'Egusi' Melon Production Inputs

The allocative efficiency values of production inputs are the ratios of MVPs to MFCs of the various inputs. The MVP of an input in this case is the product of its estimated production function parameter, marginal physical product and price of output. The estimated parameters of the production function are presented in table 2. The results indicated that all the inputs positively influenced 'egusi' melon production output, however, only the land and fertilizer inputs impacted significantly on output. This implies that increase in output of melon production in the area depends significantly on land and fertilizer inputs. For instance, a 10% increase in land area cultivated would lead to a 4.26% increase in output.

Further results of the analysis (Table 3) indicated allocative efficiency values of 1.14, 0.64, 0.08, 17.44, 0.83 and 1.76 for land, family labour, hired labour, fertilizer, capital and seed inputs respectively. By these results, labour and capital inputs with allocative efficiency values below one were over-utilized while land, fertilizer and seed inputs were under- utilized having values greater than one. The reason behind over-utilization of labour (both family and hired labour) inputs could be attributed to high cost of labour necessitated by its scarcity in the area. Another reason could be that the melon crop was regarded as a minor income yielding crop among the different crop mixtures in the area and going by the records of Yusuf et al. (2008). This result agrees with Ugwumba (2010) who reported over utilization of labour input in catfish production in Anambra State. However, it is at variance with Fashola (2000) who reported under-utilization of labour for fish production in Owerri Agricultural zone of Imo State. In addition, Ugwumba (2010), contrary to the result, noted under-utilization of the capital input in catfish production in Anambra State.

The land, fertilizer and seed inputs were

Table 2: Estimated Cobb-Douglas production function output

Variable	*Parameter*	*t-statistic value*	*Probability*
Constant	2.145	7.63	0.003
Land	0.426	12.14	0.000
Family labour	0.162	1.86	0.574
Hired labour	0.022	0.58	0.765
Fertilizer	0.218	2.38	0.012
Capital	0.062	0.37	0.361
Seeds	0.110	1.08	0.823

Source: Field survey 2009

Table 3: Estimated marginal value products, marginal factor costs and allocative efficiency values

Input	*MVP*	*MFC*	*Allocative efficiency value*	*Decision*
Land	1,704	1,500	1.14	Under utilization
Family labour	640	1,000	0.64	Over utilization
Hired labour	88	1,250	0.08	Over utilization
Fertilizer	872	50	17.44	Under utilization
Capital	248	300	0.83	Over utilization
Seeds	440	250	1.76	Under utilization

Source: Field survey 2010

under-utilized probably because majority of the farmers owned land through inheritance which is the major reason behind land fragmentation leading to reduction in farm area available for crop cultivation as well as reduction in quantities of fertilizer and seed inputs used in the production process. Under -utilization of the fertilizer input might be traced to its insufficient utilization due to untimely supplies, low capital base of the farmers and scarcity of the product. The seed input was under utilized, meaning that the farmers either scaled down the quantity planted or did not plant the appropriate population to guarantee maximum yield. Therefore, output of 'egusi' melon in the study area could be improved by targeting optimization of land, fertilizer and seed inputs' use, by the adoption of adequate modern farming practices. Such practices might include early sourcing of enough quality and quantity fertilizers and seeds, increasing size of land under cultivation even by early planting of swamp plots, and sourcing of cheap credit facilities for the provision of more of the under utilized inputs. In addition, the farmers should explore reduction of the over utilized inputs, that is, labour and capital inputs.

Problems of 'Egusi' Melon Production in the Study Area

The production of 'egusi' melon in the area was constrained by scarcity of land, high cost of inputs, processing problems, lack of capital, cropping system, and lack of storage facilities as shown by table 4. Among these problems, scarcity of land was the major problem (87.5%) followed by high cost of inputs (57.8%), processing problems especially water scarcity and pest attack (21.7%), the dominant mixed cropping system in the area (11.7%), lack of capital (5.9%) and the least problem was that of lack of storage facilities (4%).

Table 4: Problems of 'egusu' melon production in the area

Constraint	*Frequency*	*Percentage*
Scarcity of land	53	87.5
High cost of inputs	35	57.8
Inadequate processing facilities	13	21.7
Dominant cropping system	7	11.7
Lack of capital	4	5.9
Lack of storage facilities	3	4.3

Source: Field survey 2010

CONCLUSIONS

The cultivation of 'egusi' melon in the study area has been sustained by its profitability as well as other socio-economic and cultural values. Its production output was significantly influenced by household size, cost of inputs and farm size at 5% level of probability, but weakly affected by age, education, experience and access to credit.

Production output was again positively influenced by land, family labour, hired labour, fertilizer, capital and seeds. However, only land and fertilizer inputs were significant. The results of allocative efficiency analysis indicated that labour and capital inputs were over utilized while land, fertilizer and seed inputs were under utilized. The production of 'egusi' melon in the area was seriously retarded by lack of land, high cost of inputs and processing problems. However, production output could be improved by continuous subsidization of prices of inputs especially fertilizers and seeds, expansion of extension services to enable farmers imbibe modern farming and processing techniques and provision of cheap credit facilities.

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